Dear spokesperson,

The Workshop on the Intermediate Neutrino Program (WINP) will be held at Brookhaven National Laboratory on February 4–6, 2015. The workshop organizers request that you fill out the enclosed template for describing your experimental plans by January 12, 2015 at 17:00 EST. These templates will be posted on the public WINP website and are intended to facilitate discussion on the best opportunities for neutrino experiments or R&D that can be accomplished in the intermediate time period (~5–10 years) at reasonable cost. Working group convenors may need input from you on an earlier time scale.

Steve Kettell
For the Organizing Committee

1. Name of Experiment/Project/Collaboration: CAPTAIN (Cryogenic Apparatus for Precision Tests of Argon Interactions with Neutrinos)
2. Physics Goals
    a. Primary Physics Goals Measure neutron-argon interaction properties to reduce neutrino energy reconstruction systematics in future LAR TPC experiments. Measure neutrino-argon interaction properties and spallation backgrounds below 50 MeV to determine response of a future large LAR TPC to supernova neutrinos, Measure neutrino-argon interaction properties above 2 GeV neutrino energy.
3. Expected location of the experiment/project: LANL (WNR neutron source, FNAL BNB, FNAL NuMI Hall)
4. Neutrino source: BNB, NuMI
5. Primary detector technology: Liquid Argon TPC
6. Short description of the detector: The CAPTAIN collaboration uses two detectors. The full CAPTAIN detector is a portable liquid argon TPC with a 5 tonne fiducial volume, and it is supplemented by the mini-CAPTAIN detector which has a fiducial volume of approximately 1 tonne. Both detectors will have photon detection systems that can be used as an internal trigger and provide timing information. They will also have laser systems to demonstrate operation of laser induced ionization to provide in situ calibration. The measurements in the NuMI beam line are expected to be in collaboration with MINERvA.
7. List key publications and/or archive entries describing the project/experiment.
8. Collaboration
    a. LANL, LBL, FNAL, BNL, ANL, UCDavis, UCI, UCLA, UAlabama, UHawaii, UHouston, UIndiana, UNew Mexico, UMinnesota, Stony Brook, BMCC, LSU, South Dakota State, U South Dakota
    b. Current collaborators: 67
    c. Estimated number of collaborators needed: 70
9. R&D – The CAPTAIN detectors employ the same electronics chain and similar DAQ to the MicroBooNE experiment, so no specialized R&D is required for CAPTAIN. However, some of the commissioning activities for the Mini-CAPTAIN detector have occurred before they have for MicroBooNE and much has been learned. Additionally, multiple purification systems are being deployed that include some new concepts for recirculation. The Mini-CAPTAIN detector is presently being actively commissioned. We anticipate CAPTAIN's deployment of the same electronics chain as MicroBooNE (with the same front-end as LBNE) to be mutually beneficial with experiences in one experiment benefitting the other.
10. Primary physics goal expected results/sensitivity:

a. We expect to make the first energy-dependent measurements of high-energy neutrons on the argon nucleus. This information is critical to understand the secondary interactions of neutrons, and will directly influence the understanding of neutrino energy reconstruction for the long-baseline neutrino program and studies of atmospheric neutrinos in the large underground detector anticipated for the LBN program. The measurements will be made through kinetic energies of 800 MeV. No other experiments are currently planned to carry out these measurements.
b. For the low-energy neutrino part of the scientific program, we anticipate a measurement of the charged-current electron-neutrino cross-section with 10% precision. This result will be the first demonstration of the capability of liquid argon time-projection chambers to measure neutrinos at energies relevant to supernova neutrinos. Further, due to the highly capable photon detection system, the ideal triggering and measurement approach for the LBN program will be studied with real data. In addition, we are using a tunable neutrino beam at the Crocker Nuclear Lab to measure the important spallation backgrounds to SN detection. No other experiments are currently planned to carry out these measurements.
c. For the CAPTAIN MINERvA part of the program, we anticipate millions of events in a crucial energy regime for the LBNE program – in particular in the higher-energy portion of the first oscillation maximum where several interaction channels turn on including multi-pion production and kaon production. The data will be complementary to the on-axis and off-axis data collected with the SBN detectors.

11. Experimental requirements
    a. CAPTAIN Neutron: This will be done using the mini-CAPTAIN detector in the LANL WNR neutron beam. The measurement is not limited by the beam intensity. We are requesting an exposure of approximately 1 week.
    b. CAPTAIN BNB: This will be done using the CAPTAIN detector at an off-axis position relative to the FNAL BNB. An exposure of about 4×10^{20} POT will be needed to measure the cross section to approximately 10% accuracy. This experiment can be operated parasitically without interfering with other BNB operations
    c. CAPTAIN MINERvA: This will be done using the CAPTAIN detector in conjunction with the existing MINERvA detector in the NuMI near detector hall. Assuming full NuMI power, a one year exposure would yeild about 1.5M contained events. This experiment can operate parasitically without interfereing with other NuMI operations.
12. Expected Experiment/Project time line – The Mini-CAPTAIN detector is already constructed and is undergoing commissioning. The CAPTAIN detector has its full complement of electronics, cryostat and most other materials with the following exceptions:
    a. The purification system is scheduled for delivery in March of 2015.
    b. The TPC wire-frames will have final design, fabrication and wiring subsequent to successful Mini-CAPTAIN commissioning.

    We anticipate all items are ready by the end of FY15 with commissioning during FY16. Neutron data taking will take place during FY16. The detector will subsequently be moved to FNAL where data taking will commence soon after.

13. Estimated cost range – The design, materials and much of the commissioning has been supported by LANL LDRD funding. DOE-funded groups have been supported to work on the CAPTAIN program. DOE support is sought for data-taking operations. International collaborators and support is welcome.
14. The Future – The purpose of CAPTAIN is to support the development of the LBN and SBN programs through neutron and neutrino measurements and R&D projects such as the laser calibration system. The cryostat is portable and can be repeatedly opened and closed. It can therefore be employed to test a wide variety of R&D topics. Examples of the myriad upgrades or small-scale R&D projects include the wire pitch. The current wire pitch is 3mm. Low-energy neutrino reconstruction might benefit from a smaller pitch. Other possibilities include doping the argon with xenon that change the scintillation light output and timing properties of the light.